Voices from the Interface

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Voices from the Interface

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Abstract. This is a fictional story, which marries technological advances in the field of brain computer interfacing (BCI) with the writer's interest in music, film, sport and science fiction. It occurs in two years, at the time of the London Olympics. The technology mentioned in the story is either working in specialist laboratories around the world, or indeed is under development. The aspect whereby the BCI provides a telepathic duplex communication system between humans may be plausible sometime in the future, but currently is the realms of science fiction. The information provided as the context to the imagined dialog is true and can be evidenced by appropriate searching.

Keywords. Fiction, Brain Computer Interface, Springsteen, Guardian Angel, Human Web

1. The moment of truth arrives

July 2012, Belfast, Northern Ireland.

Can brain computer interfaces ever work for the general population? I had been contemplating this question for the last four years and now was the moment of truth. Of course our research would end in disappointment, I was sure of it. Most scientific research does. I had been writing a draft of my latest research article, '*A Brain Computer Interface for Everyone in 2020?*'. This paper was the culmination of a collaborative research project, with many distinguished colleagues from top research institutions and companies in Europe. The title of the paper was optimistic, more so than I was in reality. The European Commission had put faith in us and provided significant funding. We started the project with high hopes. We were going to use brain computer interface to include people in society. The prototypes were promising, but there were so many technical obstacles still to overcome.

Today we had received the final prototype, delivered to the 'smart homes' lab at the university. This looked more like a cycling helmet than an electrode cap. It had arrived too late on a Friday afternoon to do any testing. Anyway most people were too absorbed in the London Olympics to stay late in the lab that day. Wendy Houvenaghel[1], the local girl from Northern Ireland was in the cycling individual pursuit final, later that night. Could it be gold this time? The whole country held its breath. Perhaps if she wore the new Brain Computer Interface helmet, she could go one better than Beijing. I

[1] Houvenaghel won Silver medal at the Beijing Olympic Games in the cycling individual pursuit.

could only dream ("dream baby dream, come on baby you gotta keep those dreams burnin'")[2].

2. A smart home

I loved to watch sport on television, but sometimes there was too much at stake to enjoy the event. Lately, I found it harder to watch live events. But there were great times which seemed to owe much to divine intervention. Liverpool defeated AC Milan in the 2005 Champions league final. How could a team come back from 3-0 at half-time against the great Milan side? Did it really happen? A win on penalties with Polish hero Jersey "spaghetti legs" Dudek saving two penalties, what genius! Or indeed, Ireland's rugby grand slam in 2009, the first for 61 years. A drop goal from Ronan O'Gara two minutes from time to give Ireland a 17-15 lead. Then how did the final Wales penalty from Steven Jones fall a foot short of the posts – the last kick of the game? There must be a higher force.

I switched on the television. Actually television does not do it justice. It was a 'media centre', thanks to our Spanish collaborators, from a multinational telco. At the touch of a button on the remote, I could watch a channel, switch to the digital radio or audio system, pull up any of my photographs or movies, search an internet site, or do a video tele-presence with my brother in the USA – as long as he was up, of course. I remembered back to my childhood, watching the moon landings on a black and white television, taking a minute to warm up and then disappearing into a dot in the centre of the screen, when the plug was pulled. I remembered Brazil wining the world cup in Mexico – in colour; the great team: Pele, Tostao, Gerson, Rivellino, Carlos Aberto, and many more. I thought back to Space Invaders on the first games console, when I was just beginning university at the time. Wow, we have come a long way. Technology really does work. Time for some optimism!

Actually my home communication system has been upgraded a couple of years ago, to allow me to test the brain computer interface prototypes outside the lab. Everything was now linked together as a 'smart home' with a clever data bus[3] that allowed wireless access. I could even open the windows and doors with the same remote control and the television. This was a truly intelligent ambient environment; a testimony to the advances in pervasive computing taught as part of our final year "Networks" and "Emerging Healthcare" modules on our degree course.

However I was no couch potato. My demanding second life 'coach' avatar saw to that. It would use my phone to count my steps when walking, work out my pace, when jogging, advise me of appropriate routes, using GPS, and alert me to possible running colleagues in the vicinity – as if I wanted the company. More and more, I was training with my brother in Ohio. In 2012, geography was no longer the tyranny that condemned a previous generation of 'potato famine'[4] exiles to a new life in the USA, severing all ties with loved ones in Ireland.

[2] 'Dream baby dream', a song by the group Suicide, which Bruce Springsteen finished his set with during the 2005 'Devils and Dust' tour.

[3] The smart home involves technology such as X10, with 'plug and play' discoverable devices.

[4] Ireland suffered a failure of the potato crop in 1845, resulting in mass emigration to the 'new world'.

3. Polish Vodka

I watched the television, or at least interacted with it. I switched from channel to channel looking for something interesting to watch. I remembered the Bruce Springsteen song, '*57 Channels (And Nothin On)*'. It seemed ironic, great media system but nothing to watch. Still the cycling would be on later that evening. I often used Bruce's lyrics in my lectures. He was my hero. I'm not sure what the students made of it, but there were so many songs that a Springsteen quote for every lecture was possible. I would even slip a subtle reference into academic meetings and papers. Nobody seemed to notice!

I stared at the parcel - the final brain computer interface prototype. It had been sent by courier from our amplifier partners in The Netherlands. Would it really work? Should I try it now or wait until Monday when my colleagues could help? I couldn't decide. Then a thought came to me. This would be the perfect opportunity to open the bottle of Polish vodka – a present from our signal processing partners in Warsaw. I was keeping it for an occasion such as this. This seemed the right time. Northern Ireland's first Olympic champion since Mary Peters[5] and a final prototype in the one night! I drank a vodka with tonic – it was strong. But it was just the thing to calm my nerves before the race. I had a second. I was now becoming more adventurous, more enquiring.

4. Active Electrodes

I donned the brain computer interface prototype. In this, the final prototype, our Dutch partners had replaced the standard electrodes with newly designed 'active' electrodes. These injected a small current into the scalp which greatly increased the signal to noise ratio of the recorded brain waves. The design of the bicycle type helmet also meant that good electrical contact was more easily achieved with the head. No need for messy electrode gel. The small amplifier, sitting on the table beside the media system lit up. The helmet has made Bluetooth contact, and was now paired with the amplifier, so that my brain electrical signals were being recorded into the computer at the heart of the media system.

I needed to upgrade the software in the system, as the spatial filter, signal processing and parameter extraction software had all been updated by our colleagues. A wizard sprung into action, contacted the project cloud, and attended to the house keeping. In fact all I needed to do was consent, on the computer screen which took control over the media player. I clicked 'Yes'. Are you sure? Time for another vodka. I clicked 'Yes', again. I then needed to calibrate the system. In testing of the previous prototypes, I knew that I was 'good' subject for the intended movement paradigm. This meant that I could think of moving my left arm, right arm, left foot, right foot and the computer would use these choices to navigate through the media entertainment system menus, designed with our telecommunication partners.

All seemed to go to plan! I was presented with an encouraging message giving me a ROC[6] of 90%. I knew this was good enough. I was then given a graphical menu on

[5] Mary Peters won a gold medal in the 1972 women's pentathlon and is a 'local hero'.

[6] ROC stands for Receiver Operating Characteristic. It is used by statisticians to discriminate between outcomes in tests. A value of 100% shows perfect discrimination.

the screen. I could navigate around the various rooms in the house quite reliably. There were some errors of course, but there are always errors – as long as I could easily recover all would be well. I navigated the interface to go to the kitchen. There I could open or close windows or doors, put the cooker or dishwasher on, without leaving my sofa. I thought to open the window. I could feel the draft. It worked. I poured myself a long one, to celebrate.

My colleagues at university would be delighted, when I told them on Monday. They had worked hard for this moment. This could be 'the' new technology. It would help people with severe movement difficulties of our partners in Belfast. This was the main reason for the research. It would include people in society, who were currently excluded. Of course, it also would help lazy people! It could bring interactive gaming to a new level. This is where the real money could be made. Our industrial colleagues would be delighted. Our funding would be vindicated.

5. Is there anybody alive out there?

I experimented with the prototype. The intended movement paradigm was quite exhausting, but the feedback from the computer was encouraging and motivating. I could easily recover from errors. I eventually navigated to channel 101 to watch the build up to the cycling.

At least that's what I intended. Dam!, I must be getting tired. Somehow, I ended up at the music player. Well, I may as well play a song to check it out. I selected Bruce's 'Radio Nowhere', from the 'Magic' album. It's a killer track – one of my favorites. I sang along. "This is radio nowhere, is there anybody alive out there?, This is radio nowhere, is there anybody alive out there?"
"Yes, I'm here, what are you doing on this channel?"
I must be getting tired. Had I started up the chat icon, in error? Then, the music stopped.
"Are you still on this channel?"
"Who's on earth is that", I thought, without uttering a syllable.
"It's Bruce. This is my channel. How did you get here?"
Did the media system just read my mind?
"Bruce who?", I pondered .
"It's the Boss".
I was confused. "Are you talking to me?", I thought, a little more assuredly.
"Is that Bob DeNiro?[7] *You should be on channel 47. This is my private channel, for songwriting"*.
"No, it's Paul", I ventured.
"Paul. I'm not sure how you got the key for this channel, but it's private. I have many works in progress here".
"Wow!".
"Bbb..ruce, I've stumbled upon this channel by mistake. I didn't mean to…"
"Are you with the CIA[8]*? I'll have a word with Barack about this. This is an encrypted secure channel"*.

[7] This line was used in Robert DeNiro's breakthrough file was Martin Scorsese's 'Taxi Driver' (1976)
[8] CIA is the Central Intelligence Agency in the USA.

"Bruce, it's Paul from Ireland. I'm using a new brain computer interface. I'm not sure how we linked up", I replied (or at least thought!).
"Well, I'm going to have a word with Clarence"
"Is the Big Man[9] on this channel too?", I thought.
"Not that Clarence, the angel – I mean. He's in charge"

6. The Human Web

I suspected an abrupt end of the conversation was about to occur, and I wanted to prolong it.
"It's a Wonderful Life[10] was real?" I asked.
"Of course, the film depicted a real event" said Bruce.
"I saw you with Barrack and DeNiro in a photo, at the Whitehouse, at Christmas 2009"
"*You must be a fan. That photo only appeared on Backstreets. Are you a fan?"*
"Yes, a big fan. I've followed the band, since the day 'Darkness' was released. I was at Slane Castle in 1985."
"So were 100,000 others".
I wanted to say "You didn't notice me in the crowd?", but of course I had already thought it. No place to hide.
"Maybe I did, can't really say. Your hair has changed?" Bruce replied.
I knew it! Bruce had magical powers. He must be some sort of a songwriting druid.
How many people have these channels?", I enquired.
"There's 57 of us. We're the 'movers and shakers'. We running things, now – using our contacts, Facebook, Twitter and all that."[11]
"Was it a special summit with Obama?"
"Yes, Barrack was looking for some advice back then, medical reform – I think. Clarence called us (me and Bob) over. We've had bit more experience than the young kid. Luckily Clarence managed to get out of shot, just as the photo was taken. He doesn't like to be photographed these days."

I'd heard of a Human Web theory of six degrees of separation[12]. If a person is one step away from each person they know and two steps away from each person who is known by one of the people they know, then everyone is at most six steps away from any other person. There must only be 57 'movers and shakers' connected to everyone else. Could it be true?
"So there's Clarence, you, Obama, and DeNiro. Who else is there?"
"I really can't say".
"Is there anybody in Northern Ireland? Just tell me this"
"There was George Best, but now it's down to Christine Blakely"[13]

[9] Clarence Clemons is the saxophone player in Bruce the E-Street Band. He is known as the 'Big Man'.
[10] It's a wonderful life is a film in which Clarence Goodbody is an angel!
[11] Springsteen supported Obama presidential bid in 2008. Obama used WEB2.0 to organise supporters.
[12] This has been brought to prominence by Kevin Bacon, the Hollywood actor.
[13] George Best was a famous footballer and Christine Blakely is a television presenter in the UK, Both are from Northern Ireland.

It all began to make sense. However could Blakely get that 'One Show' spot without being a 'mover and shaker'. How did she get rid of Mylene? Think of the influence she has.
"Am I one – a mover and shaker?".
"No, don't think so".
"Pity, but I thought so"

So how did I get onto Bruce's channel. This needed some careful thought, but not while in this channel. Could this be like the mysterious 'Troposphere' from Scarlett Thomas's novel, 'The end of Mr Y'?
"Thanks Bruce. How do I leave?"
"Tune to channel 1. Ask Clarence to help."
"By the way Bruce, great performance at Superbowl XLIII. Did you influence the outcome at the end? Are you a Steelers fan?"[14]
"Can't say."
"Can I come back, sometime?"
"Sure, meet me at Mary's place"
"Thanks Bruce."

I now had to figure out how to leave Bruce's channel. I thought 'left hand' and I heard the noise that you get as you re-tune a radio, but I must still have been in Bruce's private channel as I could see various doors: 'Born To Run', 'Tom Joad', 'Mary's Place', 'Working on a dream'. I wondered if I was now part of the dream. Could I open the doors using the brain computer interface? Then I saw 'Candy's Room'. I knew that I didn't want to walk the darkness of Candy's hall. I had to leave. I thought 'left foot'. That did the trick.

As I thought more of the 'left foot', the navigation speeded up and encounters became a blur. I'm sure I passed David Tennant[15], somewhere. Is 'Dr Who' real? Are there time travelers? I must have missed Fernando Torres[16], as I'm sure he must have a channel somewhere.

7. Every time a bell rings

I eventually made it to channel 1, I think. I was met by Clarence Oddbody. I quickly had to think 'right foot' to stop or I would have gone full circle to channel 57.
"Well, what are you doing here?", Clarence enquired.
"Not quite sure. I think it's something to do with active electrodes", I thought.
"Yes, powerful Magic", said Clarence.
"Clarence, can you do me a favour, before I leave?"
"Not Liverpool again!"
"Did you do that, in 2006?", I was aghast.
"Can't say", with a wry smile.
"Can you make sure that Wendy Houvenaghel has a good ride tonight? The whole country is with her"

[14] The Steelers won the Superbowl XLIII in the final minute.
[15] David Tennant played Dr Who, a celebrated British sci-fi series.
[16] Fernando Torres plays for Liverpool and Spain

"You should have asked Chris Hoy, channel 32", Clarence replied.
"Didn't see him. He's probably very busy", I thought.
"I'll see what I can do. I'll need to contact Wendy's guardian angel. She won't be pleased, but she is in need of a leg up, so it's probably a good time. But first you must tell me about active electrodes, so that I can download a security patch from the cloud"
"Bill Gates, as well! Wonder which room?", I thought.
"An even higher authority", Clarence replied.

Brain computer interfaces today are supposed to be passive. They should allow people to control their environment but not vice-versa. How could they provide a two-way channel? "This is my only explanation. The active electrodes inject a current into the brain. That current can be influenced by the electromagnetic field of the earth. Trans-magnetic stimulation works this way. Only tiny perturbations are needed to influence thoughts. The electrodes' current is a carrier, which can be modulated by the magnetic fields produced by others. The electromagnetic perturbations can be reflected off the ionosphere, like long wave radio. Thus somebody 'thinking' in New Jersey can, if the weather conditions are right, distort the electromagnetic field and influence the thoughts of somebody living in Northern Ireland, if they are wearing a brain computer interface with active electrodes. But how could this work the other way?
Maybe this is how a psychic works? Maybe people with affective diseases are more susceptible and don't even need the electrodes. That's why they hear voices. Maybe highly artistic people like Bruce can connect directly with their followers, through a consciousness, based on shared experience. How else can artists connect with their audience?"

"I'm impressed. It sounds entirely plausible. I knew that 'cloud' computing would cause problems. I preferred the secure channel. We'll need to strengthen the encryption, and switch to code division multiple access, when we upgrade. I'll have to talk to the Intel boys", said Clarence. The sound faded.

But why do the 57 channels exist? Where are these channels on the media player? How are the 'movers and shakers' chosen? I would never explain these issues. I had many more questions to answer, and this was the only place I could think properly and get answers. I wanted to ask Clarence, but now I was tired and my control was fading. I got a message on the screen. "ERROR 101: ROC less than 70". I slipped away. Brain computer interface control is indeed tiring.

8. Reality

The breeze picks up and blows a draft into my face. I'm coming around now from a deep 'dream'. But, I'd left the window open. How could I do that? Hurray, the Brain Computer Interface did work. I wasn't dreaming, but my head was sore. Never again! No more Polish vodka – even for a celebration. The media centre is showing television channel 101. Wendy Houvenaghel is second in the pursuit. It's the last lap. Not another silver! Not a repeat of Beijing! She needs a leg up. The screen door slams. The breeze rattles the chimes in the kitchen.…
"Is a dream a lie if it don't come true or is it something worse?" [The River]

Discussion of how the story relates to published work and vision for advancing scientific research (2 pages)

The fictional story is based on the following scientific evidence and background material

- BRAIN, Brain Computer Interface (BCI) project [3].
- "The Big Man" [6], which is a recently published biography of Clarence Clemons, the legendary saxophone player with Bruce Springsteen and the E-Street Band.
- "It's a Wonderful Life" [5], a marvelous, optimistic 1946 film starring James Stewart and Henry Travers, as Clarence Oddbody.

The story is a confluence of an EU funded research project (BRAIN), the legendary music artist (Bruce Springsteen [15]) and the film (It's a Wonderful Life), with short cameos from actor (Robert DeNiro), football club (Liverpool), Ireland rugby and a backdrop of Northern Ireland culture. It is set in the future, during the London 2012 Olympics, at which Northern Ireland cyclist, Wendy Houvenaghel, will aim for a goal medal. This event coincides with the completion of the EU BRAIN project. It is written in the style of a fictional conversation, used to good effect by Clarence Clemons and Don Reno in the 'Big Man' autobiography. It also explores areas, which Scarlett Thomas addressed by using a shared consciousness troposphere in 'The End of Mr Y' [16]. There are two interwoven dreams: Olympic gold for Houvenaghel and a scientific breakthrough for the research project.

Scientific progress in the BRAIN project has been published at the Augmented Human Conference [10], the 7th International Conference on Wearable Nano and Micro technologies for Personalised Health [11] and a further paper has been accepted by MEDINFO [12]. This project introduces a new graphical user interface, links BCI to a smart home, provides a wizard to help to automate set-up, and updates signal progressing modules.

Degenerative diseases or accidents can leave a person paralyzed yet with full mental function. There has been significant research into creating brain mediated computer control [17, 18] and assistive equipment that can be controlled by the brain, such as a wheelchair mounted robotic arm system [9]. A BCI may be defined as a system that should translate a subject's intent (thoughts) into a technical control signal without resorting to the classical neuromuscular communication channels [2]. The key components are signal acquisition to acquire the electroencephalogram (EEG), signal processing to extract relevant features and translation software to provide appropriate commands to an application. Applications include computer and environmental control, but entertainment applications are also under investigation. It is of course possible that the application could provide some opportunity for self expression and creativity. Some possibilities of BCI for augmenting the human include listening to music, controlling photographs, watching films, or influencing music or visual arts.

BRAIN was funded by the EU Framework 7 e-inclusion programme. The aim is to include people with severe disability by providing BCI control, and taking BCI out of the laboratory into a 'smart home'. University of Ulster's collaborating partners are: University of Bremen, University of Warsaw, Philips, TMS International, Telefonica, and The Cedar Foundation. The smart home concept relies upon ambient intelligence, and is a major focus of our research group at the Computer Science Research Institute,

University of Ulster. The health and wellness paradigm alluded to, is also part of my current research, in the area of assisted living [19, 8, 13]. The BRAIN project, to date, has implemented the steady state visual evoked potential paradigm with some success. Lights and domestic devices can be switched on/off, and we are currently addressing the control of a media player for entertainment (used in the story). The BRAIN consortium is also addressing the imagined movement paradigm, which requires no external stimuli. This is a 'true' BCI, where the user is in complete control by thought, and is the focus of this story. Imagined movement requires significant training and is only possible for some subjects. Yet, this is where true science can meet science fiction. It is in the realms of mind control, which has been addressed by films such as 'Minority Report' [14].

Improved electrodes are required to make further advances, and the story uses a cycling helmet prototype with active electrodes. Our consortium is investigating new electrodes (water based, not active, in our case). Active electrodes 'inject' a small current to increase the signal to noise ratio of the acquired signal, and hence, can give rise to the possible concern of somehow upsetting the equilibrium of the neural signals and potentially influencing the 'mind'. Trans-magnetic stimulation can be used to fire motor neurons, so why not active electrodes? Could the injected current from the active electrodes be influenced by the electromagnetic field close to the scalp; which in turn is a 'carrier' for the brain activity of another person? A significant scientific leap is of course required, and geographical separation requires some sort of shared network, envisaged as the 'cloud'.

Another element of the story is the linkage between 57 movers and shakers and the rest of us. John Guare's "Six Degrees of Separation" [7] explores the idea that everyone in the world is connected to everyone else in the world by a chain of no more than six acquaintances. This has been publicized in recent years by Kevin Bacon who can trace all other Hollywood actors to himself by a few leaps, through shared films [1]. In the story I have linked this to a hierarchy of movers and shakers. In fact, Obama's success in the 2008 election is put down to his use of the Internet for involving the general public in fund-raising etc. It is not far removed from this principle.

So will Brain-computer interfaces be the next big thing? There are certainly some significant technical advances in the pipeline (amplifiers, electrodes, software, communication protocols, user interface, application, and involvement with users). A European consortium, Future-BNCI (Brain/Neuronal Computer Interface) [4], is providing linkage to a number of funded projects, and should deliver significant advances in the next five years. As mentioned to in the fictional story, BCI will make advances when the wider population gets involved, through having a need satisfied. The computer games industry will probably be the bell-weather for this. Our vision is that BCI can be used to control smart home environments and entertainment options.

Beyond that is just fiction, for now?

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